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SCOOP PULLS FOR FORESTRY USE

by

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2nd Interim Report
Tests on Coop and Coop-fortified fuel as fire starters in forest fire control.

Returning to Portland on Wednesday, April 3, the writer found Lt. Hooper incapacitated with an attack of tonsillitis. He spent the following week in the hospital and was unable to participate in our activities until April 13.

Tuesday, April 4, at the suggestion of Mr. McPherson of the U. S. Forestry Service, the writer was taken to an operation of the Kuckenberg Construction Co. near Mill City, Oregon. This company had placed an order for one carload of Coop for kindling fires in slash and debris which had been cut while clearing a right-of-way for a highway.

The first problem which was presented consisted of a pile of mature apple trees which had been removed with a bull-dozer and pushed together into a fairly compact pile. A few days before, Mr. Hill. Lind, Construction Superintendent, had attempted to ignite this pile by using a quantity of Coop, and although he was able to burn a hole where the fuel was placed, he was unable to maintain sustained combustion. Our result, on repeating this test, was the same.

We then kindled a fire in a pile of fir logs and in this instance the logs had been pushed together in a long pile with the trunks of the trees parallel. The trees were of variable sizes up to 20" in diameter. The pile was perhaps 20' wide at the base by 10-12' high. Some of the trees were over 100' long. Selecting a place near the center of the pile where we could place the fuel low at the base and thus obtain natural draft up through the pile of logs, we were able to initiate a fire which was satisfactory. After several hours it was observed that this fire was self-sustaining. Mr. Hill. Lind had one of his operators present with a bull-dozer, equipped with a brush rake, with which he pushed the logs together while the fire was burning. We left at about 4 o'clock leaving instructions for the bull-dozer operator to again bunch the logs at about 9 P. M. The pile was satisfactorily consumed from the original initiation in this manner leaving only a few scattered logs such as are usually left after burning. No. doubt, these would have been consumed had they been pushed into the pile of burning embers.

On April 5, a conference was held with the Forestry engineers, and the suggestion was made that some means of forced draft might be beneficial in some of these problems. We were advised at this conference that the Forestry Service was unable to provide transportation for further work at this time. Lt. Jacobson then attempted to obtain a car from the Services, but was unable to obtain one immediately. Attempts to rent a drive-yourself car met with no success as all available cars were booked up for two and three weeks.

While investigating the possibility of renting a portable wind machine of some

kind, the writer visited the office of the Andrews' Equipment Co. who are distributors of portable construction equipment and who also maintain an equipment rental service. Mr. J. D. Andrews, after hearing the problem, suggested that he had a problem of burning Cottonwood logs which had been cleared from his own land. He had been attempting to burn a pile of this material for some time. The material constituted a pile about 10' through the base by 8' high and 40' long. Previous attempts had been made to ignite the wood after spraying with Diesel oil. We arranged for a test on April 6, for the purpose of testing a set of portable blower equipment consisting of a 15 kw. generator and a "skill-blower". This equipment enabled us to set up the generator at considerable distance from the fire. The blower weighed only a few pounds, and the power was transmitted by means of a flexible cord so that we were able to experiment with it from any angle with ease. The day before this test, an unsuccessful attempt to ignite this pile had been made although two barrels of Diesel oil had been used. Unfortunately, we did not have any Goop available. We kindled a fire in the base of the pile using less than two gallons of Diesel oil. By means of the blower we were able to intensify the flames sufficiently so that the fire continued to burn as long as the airflow continued. By manipulation of the blower, we could control the direction of the fire. When it was placed in a fixed position we could observe the progress of the fire burning ahead of the blast of air. Removal of the air resulted in the depression of the fire. The equipment was operated for several hours with no trouble whatever, and with no signs of over-heating of the engine or the electrical equipment. The following day the burning was continued by one of Mr. Andrews' farm hands. Mr. Andrews reported that the entire pile was consumed by the use of the forced draft. This test was witnessed by Mr. T. F. Maginnis of the Maginnis Construction Co. (See Test No. 7 of the table in the 1st Interim Report)

As a result of this test Mr. Andrews offered to cooperate with us in testing the same equipment on some of our other problems. The assistance and cooperation of Mr. Andrews and two other members of his organization, Mr. Charles L. Ready and Mr. E. J. Gleason, was particularly appreciated.

On the following day, April 7, the writer accompanied Mr. F. C. Maginnis to their road-clearing job near Canyon Beach, Oregon. Mr. Andrews allowed us to take the blower along with us in order that Mr. Joe Maginnis might observe it, however, we did not have an opportunity to use it on one of the big piles. The entire day was occupied in assembling and testing an improvised flame thrower which was being developed by Mr. Maginnis, as a result of the previous demonstrations of Captains Barnard and Russum. Mr. Maginnis had obtained a supply of Napalm and had made up a quantity of jellied gasoline. The improvised flame thrower utilized a pressure tank of about 60 gal. capacity for the fuel reservoir. The pressure was applied from a Nitrogen cylinder, initially 2200 lbs., reduced through a suitable valve to 100 lbs. A length of 3/4" hose and an ordinary fire nozzle having a 5/16" orifice was used for the distribution of the fuel. The only test that we made with the flame thrower was made with a batch of Napalm which was fortified with about 25% Goop. Mixing was accomplished in an open-top drum with an improvised "churn-dasher". While we were preparing the fuel and assembling the equipment, a rain storm had increased in intensity and was almost a downpour. The target selected for the test was a steep hillside having a dense growth of Salal. The growth was so dense that it was almost impossible for a man to walk through it. We emptied our tank of the 40 gal. charge and subsequently ignited the fuel by

Bunching debris and slash with a bull-dozer

Kindling fire for burning slash

throwing a firebrand into it. The heavy rain was accompanied by strong gusts of wind of variable direction. The rain was so dampening that the fire spread over only about 25% of the area sprayed with fuel. As a result, very little of the brush was destroyed. Regarding fuel distribution, the 5/16" nozzle gave about a 50' throw at 100 lbs. pressure, and considerable atomization was apparent.

At one time when the nozzle was accidently headed into the wind, a spray of Goop mix blew back into our faces and thoroughly blackened the four of us. Fortunately, we were spraying unignited fuel during this first test.

A 5 gal. sample of Diesel oil and Goop mix without a gelling agent was tested by throwing the bucket of fuel onto a dense clump of Salal. In the heavy rain the fuel was very difficult to ignite and because of the method in which the fuel was distributed, the test was not conclusive. The fire appeared to have greater intensity than the jellied gasoline, but this may have been due to the greater concentration from being thrown from an open pail. The day's operation served to initiate the equipment and to warn the operators regarding some of the hazards in its use. This apparatus is particularly hazardous when using gasoline base fuels.

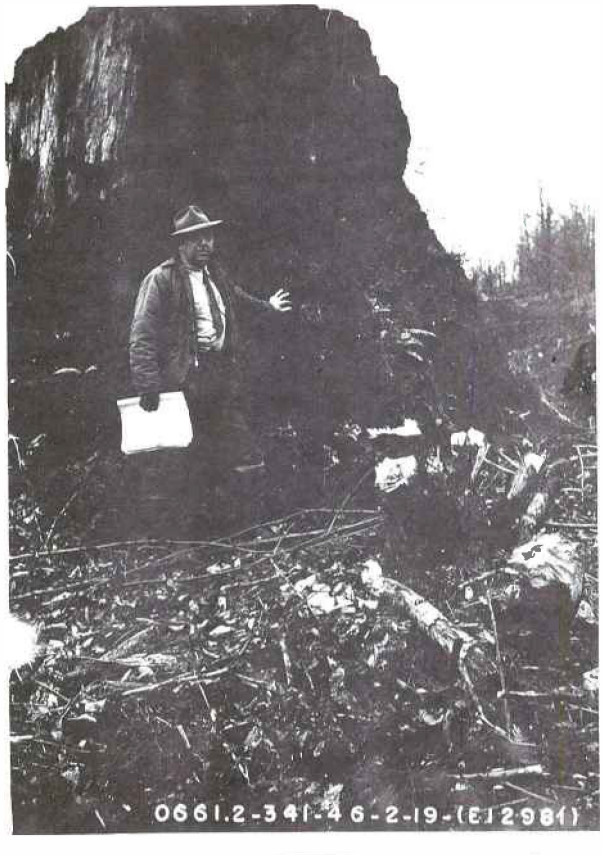
On April 8, Lt. Jacobson and the writer were invited, following a luncheon, to address the Board of Directors of the Associated General Contractors. This group is primarily interested in large construction projects, many of which have problems of clearing in the timberlands of the Northwest. After our discussion we prepared a publicity release which is to be circulated by the General Secretary to the entire membership of the Association. As a result of our talks, one of the contractors, Mr. F. H. Slate, placed an order for a carload of Goop at the conclusion of the meeting.

On April 9, we visited Mr. James D. Bell, Chief of Transmission Construction, Bonneville Power Authority. Problems of storing a quantity of Goop which Mr. Bell had ordered were considered together with a survey of his problems of maintenance along the power line right-of-way. The Bonneville Power Project has over 2500 miles of power line right-of-ways which require continual maintenance to keep down undergrowth. In addition to this the power line clearings serve as excellent fire breaks. One of the big problems is the burning of the annual small growth during the season when fires are not likely to spread to the surrounding forests. Because of the extent of this problem, Mr. Bell is particularly interested in a method of distribution of the fuel from a flame throwing device.

April 10, we returned to the Zig-Zag Ranger Station and worked on sawdust piles. Mr. Andrews furnished not only the blower equipment, but also the transportation for us. The pile of wet sawdust which we had previously tried to ignite was once again the object of our experiments. Using a relatively small quantity of Goop, we were able to kindle a fire which was sustaining only so long as we continued to use the blower.

April 11, Mr. Andrews again furnished the car and the portable blower equipment for a return trip to the Kuckenberg Construction Co. in Mill City. Here again, we operated on the pile of apple trees and again, we were able to demonstrate that we were able to initiate and maintain fires with the complementary combination of Goop and forced draft.

Typical power line right-of-way clearing



Disposal of stumps such as this, are one of the problems frequently encountered

Mr. "Larry" Kuckenberg, one of the partners, was present during this test and was able to observe the benefits which were obtained from the combination.

On April 12, a demonstration was held near Longview, Washington, on one of the Long Bell Lumber Co. properties. This test was made on one of the few dry days which we encountered. The problem consisted of a pile of mill slash, chiefly slabs, blocks and bark from cedar logs. The material had been hauled to a location in a small ravine adjacent to the road. Attempts to ignite the pile using Diesel oil had been unsuccessful. Fires were started by strategic placing of relatively small quantities of Goop at the base of the pile. Again Mr. Andrews sent out one of his cars with the portable blower equipment and one of the salesmen, Mr. A. J. Gleason, who demonstrated the improved results from forced draft. In this case self-sustaining fires were possible without the use of forced draft, but the additional air increased the burning rate appreciably.

April 13, was spent in various conferences with the U. S. Forestry Service. Of particular interest was a conference with Mr. E. B. White of the Fire Control Division, who is interested in flame throwers for possible use in backfiring during forest fires. Mr. White had received a letter from Dave Godwin suggesting that a meeting be arranged with Mr. Fred Funk who has been on a tour of the Northwest testing the portable flame thrower which uses Diesel oil. The writer was unable to contact Mr. Funk during this trip, but did call on Mr. Orr, General Manager of the Western Fire Equipment Co.

The problem of beetle control was also discussed at this time with Mr. Buckhorn, Forestry Service Entomologist, who was present at the Long Bell demonstration the previous day. The problem of the destruction of the Western Pine Beetle in the Ponderosa Pine country on the eastern slopes of the mountains was presented. For this problem, it is desirable to pump fuel for distribution in the tops of the young pine trees so that the tops can be burned out without felling the trees. It is hoped that sufficient heat can be developed to kill the larvae without the complete destruction of the tree.

Monday, April 15, a conference was held with Mr. E. T. F. Wohlenberg, Forest Counsel of the Western Forestry and Conservation Association, who arranged for a meeting on the following day with Mr. Clyde Martin, Chief Forester of the Weyerhaeuser Lumber Co. Mr. Wohlenberg also arranged for a conference with Mr. George F. Cornwall, the managing editor of The Timberman, a publication which is widely read by those who are interested in forestry problems. He received us courteously, and it is hoped that the publicity which will come from this visit will be helpful.

On April 16, we met Mr. Clyde S. Martin, Chief Forester of the Weyerhaeuser Lumber Co. and arranged for a subsequent demonstration on some of their property in Washington. By this time anxiety over starting forest fires was expressed in most of our meetings. The fire season started as of April 15, after which it is necessary for any operator to obtain a permit before any burning can be done. With a few days of warm sunshine, arrangements for making additional demonstrations were becoming very difficult.

Wednesday, April 17, was spent in Seattle. At the suggestion of the U. S. Forestry Service, the writer visited Mr. William D. Hagenstein, Forest Consultant

for the West Coast Lumbermen's Association. He had been instrumental in making many of the contacts in the state of Washington for Lt. Jacobson and Lt. Hooper, during their trip there the previous week. Mr. Hagenstein provided us with some very interesting data on Forestry problems in the state of Washington.

The writer also visited the offices of the City of Seattle Light and Power Department, and interviewed Mr. W. C. Snow, Assistant Superintendent of the Department of Light and Power, who called in a number of key men who are interested in clearing projects which include the clearing of the site for the new reservoir on the Skagit Project, as well as maintaining right-of-ways of their power lines. In the late afternoon, a trip was made to some of the right-of-ways with the Superintendent of Maintenance, Mr. G. J. Dermody. An interview was also held with Mr. Charles S. Cowan who is one of the officials of the West Coast Lumbermen's Association. He assisted in making the arrangements for the Weyerhaeuser demonstration. Mr. Cowan has been very cooperative in arranging demonstrations which might be beneficial in the over-all picture of fire control.

The writer returned to San Francisco early the morning of the 18th, where he visited Mr. Robert Orr, of the Western Fire Equipment Co. for the purpose of offering our cooperation in developing a pump which would do a better job of applying our fuels on some of the specific problems which have been presented to us.

The work so far has indicated need for locating or developing a means for distributing Goop-Diesel oil mixture, preferably with a light-weight or portable equipment. The equipment can probably be useful for both the beetle control work and the land-clearing or weed-burning job. It is also hoped that it can be used in tests of fuels for fog-dispersal.

As the snag disposal problem appears to be the greatest in reduction of forest fire hazards, further work should be done on this phase of the work. Tests which are being continued this week by the U. S. Engineers, in the Yacolt burn in southern Washington, using "Shaped-charge" explosives, may show some promise in combination with Goop; the explosive being expected to sliver the snag and improve the ignition characteristics in combination with the Goop. Mr. McPherson, U. S. Forestry Service engineer, has promised to send the results of these tests.

FVL:jct

May 22, 1946

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3rd Interim Report
Destruction of Pine
Beetles

Objective: To develop methods of control of the spread of pine beetles by the use of Goop-fortified fuels.

By permission of Mr. F. B. Keen, we quote the following which is published by the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Berkeley, California:

"When a forest is changed from a green canopy to one in which dead trees and ghost-like snags predominate, the cause is usually due to one or a combination of three destructive agencies—fire, insects, disease. In the California region two species of bark beetles are recognized as the most important of the insects which kill living trees. These are the western pine beetle (Dendroctonus brevicomis Leconte) and the mountain pine beetle (Dendroctonus monticolae Hopkins).

"More commonly these insects are known as pine beetles. In the adult stage of their life history they are tiny cylindrical black beetles, smaller than the ordinary house fly. It is the adults which initiate the attack upon the living tree by boring through the bark of the main trunk and mining the cambium layer between the bark and the wood with tunnels slightly larger in diameter than the body of the insect. This process effectively girdles the tree and causes it to die quickly.

EXTENT OF PINE LOSSES

"These two bark beetles confine their attack to pines only, and because of their depredations the most serious forest insect problems of the state are found in the pine areas of National Forests and Parks. The western pine beetle attacks Ponderosa pine, the most valuable tree for commercial use, and Coulter pine in Southern California; the mountain pine beetle attacks primarily sugar pine and lodgepole pine of the Sierra Nevada region. There are other species of insects with similar habits which do some damage but are of relatively minor importance.

"The coast redwood and the big tree have no serious insect enemies such as the pine beetle. This is one reason why the Sequoias grow to such great age and enormous size.

"Pine beetles are old established residents in their present environment and their numbers fluctuate from year to year like other forms of wild life. For long periods in any given forest area, their population may exist in relatively small numbers killing no more than 10 to 20 trees annually in each square mile of forest area. Then rather suddenly natural factors may become favorable to their increase. Great bark beetle armies are built up which spread their attack over wide forest

areas killing trees by the thousands.

"The loss of timber in California due to insects is about 500 million board feet annually when averaged over long periods. This volume of dead timber has been greatly exceeded during seasons of epidemic outbreaks, such as the approximately 1500 million board feet of potential lumber, or more than the combined total cut by the lumbermen and that killed by forest fires.

"The trees killed by bark beetles not only deprive the state of possible income from its timber resources, but National Parks and other recreational areas lose some of the finest exhibits of forest growth as well. Trees which have been centuries in growing to attain their great size are suddenly killed by the work of a tiny insect." (End quote)

The method so far used has been to peel the bark from the upper half of a log after felling the tree. This contaminated bark together with limbs and other debris is piled along the side of the tree and ignited. This provides sufficient heat to effectively destroy infestation.

Greatest labor is involved in the peeling of the bark and it is in this connection that a suggestion was made that the use of Goop-fortified fuels might permit treatment without removing the bark.

Because of the fire hazard it is essential that beetle control work be done during the season when the forest is wet or even protected by snow. At this time, also, forestry personnel is more available for this type of work because of their release from lookout posts and other fire control work. It is for this reason that Goop fuels will be useful because of its inherent characteristic of burning readily under extremely wet conditions.

This problem was first presented to us by State Forester J. A. Glenn at Santa Rosa, and was the subject of our first tests on the trip covered by the 1st Interim Report. At that time we had available only stock of the original Type C Goop. It was found that this material was not practical because of the difficulty in handling. The subject was again brought up during a conference of U. S. Forestry Engineers at the office of Mr. C. Otto Lindh in Portland, Oregon. Later, Mr. Buckhorn, one of the entomologists from the Portland office, witnessed tests of mill slash burning at one of the operations of the Long Bell Lumber Co. near Longview, Washington. A small quantity of slurry was mixed in the field with Diesel oil and burned on a convenient log to demonstrate the nature of the fuel. Mr. Buckhorn recommended that we contact Mr. P. P. Keen, Chief Entomologist at the Division Office, Giannini Hall, University of California at Berkeley, California.

Accompanied by Major Bliss, the writer visited Mr. Keen on May 3, at which time we were also introduced to Mr. George Struble, the entomologist in charge of experimental work on beetle control. Arrangements were made for field tests to be conducted near Pine Crest, Tuolumne County, California.

To provide a method of convenient distribution of the Goop slurry, we procured a small "Blackmer" Rotary Pump which appeared to have the necessary characteristics for handling a fuel containing some abrasive material. This pump was used to replace a centrifugal pump which was mounted on a trailer originally directly

connected to a Wisconsin air-cooled, gasoline engine. To provide proper speed for operation of the new pump, a reduction gear was included in the new assembly.

The new assembly was tested on Saturday, May 11, and performed with apparent satisfaction.

Two barrels of slurry were prepared from a stock of base mix we had on hand at Permanente. The material was screened through a fourteen mesh screen to remove the large lumps of coke. One barrel of screened slurry was carried in the trailer and the other in the pick-up together with another barrel of base mix which was taken "as is", without dilution or straining.

On Monday, May 13, the writer and Mr. Eugene Bayne of Permanente met Major Bliss of the S.P.C.W.S.P.D. and Mr. George Struble at Manteca where we picked up two barrels of Type C Goop, which were taken along in the Department of Agriculture's pick-up. This material was later left at the Ranger Station at Sonora for the use of the Forest Rangers there, either for slash burning or for subsequent dilution for use in beetle control.

Arriving at Pine Crest at 2:30 P. M., we immediately proceeded to the location of a Sugar pine badly infested with beetles which had been felled the day previously and treated by a crew of forestry men by peeling the bark from the upper portion of the log. Subsequently, this bark along with other debris resulting from falling the tree was placed at the base of the log and burned.

This bark was approximately three inches thick near the base of the tree. Examination showed live adult beetles and larvae on the top side of the tree trunk in a portion from which the bark had not been removed. A 5 gal. pail of base mix was spread over an area of approximately 2½ x 8'. After ignition the flames were 15' to 20' high. There was some worry about the surrounding pines, however, the burn was of short duration (about 8 minutes) and no damage resulted. A glowing residue remained for about 10 to 15 minutes. Subsequent examination showed that the beetles and larvae were still alive.

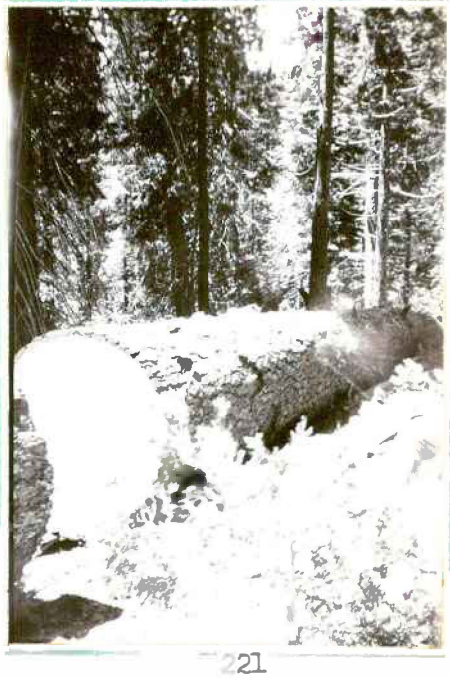
This first tree was located close to several mountain cabins and because of the unexpectedly high flames which we encountered in this first test, it was decided to conduct further experiments at a more remote location from the cabin sites.

Another sugar pine tree had been cut which was 56" diameter at breast height. The lower portion of the tree, about 20', was not infected by beetles in numbers enough to warrant treatment. Several cuts had been taken through the tree from which we obtained some sample specimens of infected bark. These pieces, each approximately 3 sq. ft., were used for some preliminary tests to obtain data, by means of a thermocouple, on the rate of heat transfer through the bark.

It had previously been established that it was necessary to obtain a minimum temperature of 120°F. to kill the eggs, larvae and adult beetles.

We bored slanting holes through the bark to the area which was infected by the beetles. In these holes we placed thermocouple wires after which the holes were stemmed with bark shavings. Three different methods of application were tested. This data shows clearly that time is an important factor in the use of any type of heat because of the low thermal conductivity of the pine bark.

218
Trailer with slurry drum and pump.



21
Infected Sugar Pine log, 56" diameter at breast height, bark, 2" thick.

224
Application of Goop slurry with pump through hose and nozzle.

222
Stream of slurry being applied from hose and nozzle at left, not shown.

223
Flame height was not too high with treatment of slurry plus 3" of pine needles plus 2" of earth.

The first method using a thin layer of Coop slurry alone was ineffectual in killing either the larvae or the adult beetles. The second method used a 3" layer of sawdust placed over the Coop slurry and was an improvement over the first method. The third method gave the best result of the three. This consisted of first applying a thin layer of Coop, then approximately three inches of pine needles and over this was placed about two inches of moist earth. With this combination, the slurry provided the initial rapid ignition and certain propagation of fire. The pine needles provided a porous layer of additional fuel which naturally lengthened the time of residual burn. The top layer of earth provided heat insulation serving to confine the heat as well as to retard the rate of burn.

After obtaining the above preliminary data, the next portion consisting of about 40' of the trunk of the tree was marked off in 5' lengths where it was our intent to experiment with several methods of treatment similar to those on the small blocks as has been described. Coop was applied by means of the spray pump which was mounted on the trailer. The fuel used in this first test was made of base mix, G-3. It had been diluted with Diesel oil, approximately 50/50 by weight. The pump proved to be more than adequate for the distribution of the fuel. Slurry was sprayed on the top and side of the log for a distance of from 35 to 40' from the lower cut. Because of the spattering of the fuel it was necessary to relieve the pressure by means of the by-pass which we had installed. After the first application of Coop, the pine needles on the ground surrounding the log were raked in close by the sides of the log. This operation provided a mixing of some moist debris and the Coop slurry from the spattering. This ignited spontaneously before we had an opportunity to prepare the section of the tree trunk with the additional needles and earth as has been described.

Flames from this first burn were much too high to be comfortable, reaching a maximum of about 25'. Radiant heat was so intense that pine needles were ignited beyond our fire lines in a few places. However, we had adequate equipment and help and the fire did not progress beyond our control.

After this fire had subsided, we examined the log for pest mortality. The bark, itself, had been burned from the underside of the log where the fuel had been placed around the tree. The top half of the log had not been effectively treated and a large number of living specimens were found. Contact pyrometer readings were taken by chopping through the bark and quickly applying the point of a sensitive pyrometer near the cambium layer. No temperature of over 100°F. was found, hence, no kill was obtained because of the heat resistance of the bark.

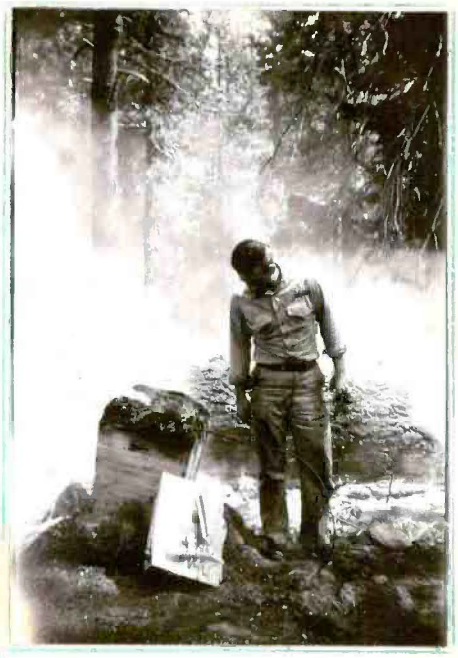
We next prepared another section of the log of about 10' as originally planned with the pine needles and the dirt. This arrangement was effective in subduing the flame so that an average flame height of 6 to 7' was obtained. The residual fuel was still smoldering actively when we left for the night after clearing an adequate fire line around the area.

Examination of this area the following day showed a 100% kill of the beetle in all stages of development. About 8 sq. ft. of treated area was uncovered in this examination under which no sign of life remained.

Another treatment was suggested by Mr. Miller, District Ranger of Sonoma. This

225
Foreground: effective treatment of test block with slurry plus 2" sawdust (after ignition.) Background: treatment with 3" pine needles plus 2" earth (before ignition).

219
Treatment with slurry and sawdust dap on test block. Flame height about 40".



220
Treatment of test block with slurry plus 3" layer of pine needles. Note thermocouple wire leading to block.

226
Flames 8' high from straight base mix applied at 3 gal. per square yard. Treatment effective, but excessive fuel required.

236
4' flame resulting from application of Diesel oil, base mix, 50/50, dilution at 1 gal. per square yard. Treatment ineffective because of short burning time.

was that some sheets of corrugated iron or some similar material be placed over the fuel to provide a radiating surface and to confine the heat over the surface of the log. From a nearby refuse dump we obtained several sheets of galvanized iron and for subsequent use we prepared two more sections of the tree. The first 10' of this utilized only a layer of Coop on top of the trunk of the tree over which the iron was placed. The next 10' had a layer of about 4" of pine needles and over this the sheets of iron were placed. Before the placement of the Coop, Mr. Struble examined the log and disclosed a very heavy brood estimated by him to be 100 to 150 per square foot of eggs, pupae, larvae and adult beetles.

Both these sections gave a burn similar to the one we had treated with earth over the pine needles. The usual debris was placed at the sides of the tree around both of these sections. The iron which was draped over the top served to confine considerable heat from the fuel beneath the tree. As soon as the fire had subsided sufficiently for us to approach the log, we chopped through to the cambium layer and took contact pyrometer readings. These varied from 140° to 170°F.; in all instances being ample to insure complete destruction of all insect life.

As a result of these successes, we went back to the other section of the tree which had been ineffectually treated the previous day. Applying another thin layer of Coop to the upper portion of the old section, half of which was covered with a layer of green pine needles, the balance being treated with about 4" of dry pine needles as in the previous test. These were ignited at about the same time. It was found that the fire progressed more rapidly and with better effectiveness in the area with the green pine needles. Perhaps this was because the dry pine needles contained a larger percent of dirt. Again the usual fuel was burned at the base of the tree to provide a source of heat for the side walls which were not conveniently treated with the Coop fuel.

A total of about one barrel of fuel was used to treat this sugar pine tree, however, as a portion of it had to be done twice, it is estimated that similar results could have been obtained with Coop slurry applied at the rate of one gallon per square yard, provided the blanket of pine needles or the metallic shield is used. Whatever method is used it is necessary to provide a source of heat of long duration because of the great resistivity of the bark.

On the morning of May 15, we experimented on a Ponderosa pine tree at another location. Starting with 8' sections cut from the top of the tree, we made small scale tests using first the base mix, C-1, without dilution. Three gallons were applied to a section covering approximately one square yard. This was burned without application of needles or other additions. While this section was being treated, another section was being prepared with only one gallon per square yard. The third section was treated with a mixture of Type C Coop and Diesel oil, 50% of each by volume, which was mixed at the site. This was applied at the rate of one gallon per square yard.

Examination of mortality after the fire had cooled on the test with the relatively large quantity of fuel, gave a good result; all insect life was destroyed. The second one with only one gallon per square yard was less effective and a few live insects were found. On the third section, the debris produced such an intense fire that the test was not conclusive. On the basis of this test it was decided to treat the balance, of about 60', of the infected area of this log. The

229
Goop slurry applied on 60' section of Ponderosa Pine log. Workmen constructing fire break prior to ignition.

233
Log cut to fall down slope. Photo shortly after ignition at butt end of log.

231
Slurry burn progresses relatively slowly. Burning debris at sides of log provides sufficient heat for treatment of lower half. The effect lasts for several hours.

228
15 minutes required for progress of burn to small end of log.

232
Glowing residue sustained heat for about 20 minutes after oil fire had burned out.

bark on this log was much more dense then that of the sugar pine and was very tenacious which made stripping the bark a difficult task. Approximately 15 gal. of slurry were distributed along the length of this log and the usual debris piled along the sides. Ignition was initiated at the butt of the log, which was the high end, and it required approximately 15 minutes for the flames to progress down grade the length of the log. The flames were 10 to 12' high during the progress of the fire. Examination the following day showed that most of the insects had been destroyed by this treatment, however, along the butt end of the log some live specimens were found near the top side of the section where there was not a great deal of fuel placed on the ground under the log. From this result, it was concluded that the application of the needles, or some similar method, would be necessary to be certain of complete destruction of the brood.

On our return we stopped at the Sonoma Forest Ranger Station where Mr. Struble gave a verbal report of our tests to District Ranger Miller. Ranger Gray, his assistant, had recognized the possibility of using the Geop slurry to advantage for backfiring during forest fires. Some discussion was had over the possibility of developing a light-weight, back-pack outfit which could be used for this purpose.

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